PENNS CREEK BRIDGE
State Route 1014
Selinsgrove vicinity
Snyder County
Pennsylvania

HAER No. PA-284

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Northeast Region
Philadelphia Support Office
U.S. Custom House
200 Chestnut Street
Philadelphia, P.A. 19106

HISTORIC AMERICAN ENGINEERING RECORD

PENNS CREEK BRIDGE

HAER No. PA-284

HAER
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Location: State Route 1014 at Penns Creek
Selinsgrove vicinity
Snyder County, Pennsylvania
UTM: 18.342200.4520860
Quad: Sunbury, PA, 1:24,000

Date of Construction: 1919

Engineer: Gustav A. Flink

Fabricator: Whittaker and Diehl

Present Owner: Commonwealth of Pennsylvania
Department of Transportation
Transportation and Safety Building
Harrisburg, Pennsylvania 17120

Present Use: Vehicular bridge

Significance: Penns Creek Bridge is an unusually ornamented example of a multiple-span concrete barrel arch bridge. Parapet walls follow the graceful humpback curve of the bridge and employ a molded concrete star pattern used on few concrete bridges in Pennsylvania. Penns Creek Bridge was listed in the National Register on June 22, 1988.

Project Information: A Pennsylvania Department of Transportation (PennDOT) evaluation recommended replacement of the bridge to meet present design standards and accommodate anticipated traffic volumes on S.R. 1014. In an effort to mitigate the adverse effect of demolition, a Memorandum of Agreement (MOA) was executed among the Federal Highway Administration, the Pennsylvania Department of Transportation, the Pennsylvania State Historic Preservation Officer, and the Advisory Council on Historic Preservation. The MOA stipulates that the existing bridge be recorded to standards of the Historic American Engineering Record.

Preparers of Documentation: Richard Meyer/Principal Architectural Historian
Douglas C. McVarish/Project Architectural Historian

John Milner Associates, Inc.
309 North Matlack Street
West Chester, Pennsylvania 19380

DESCRIPTION OF BRIDGE AND SETTING

Penns Creek Bridge carries State Route 1014, known locally as Mill Road, over Penns Creek. It marks a bridge crossing that probably dates from the mid-nineteenth century (Beers 1868). Penns Creek begins in Centre County and originally flowed 50 miles before entering the Susquehanna River north of Selinsgrove (Dunkelberger 1948:44). It has since been partially rerouted and joins Middle Creek south of Selinsgrove. Immediately west of Penns Creek, State Route 1014 intersects State Route 204. Northwest of the bridge is a late twentieth century house, set on the sloping bank of Penns Creek. North of the bridge is a wooded area. Northeast of the bridge is a wood framed and brick grist mill, while southeast of the bridge is a small farmstead and an adjacent open field, planted in corn and alfalfa. The mill and farmstead each date from ca.1859 (Meyer 1990).

Penns Creek Bridge is a double-span, concrete barrel arched structure, aligned perpendicular to the creek. Each of the closed-spandrel arches is 82 feet in length. The bridge deck measures 16 feet 8 inches in width. The arches are separated by a molded pilaster, extending from pier to parapet. Parapet walls follow the graceful humpback profile of the deck and are ornamented with a molded concrete star pattern.

The bridge is supported on a center pier that rests in the middle of Penns Creek. This battered pier is constructed of smooth-finish concrete. The ends of this pier are triangle-shaped and are surmounted by rounded caps. The ends of the arched spans are anchored to the banks of the creek by concrete abutments. These abutments are curved slightly outward from the ends of the bridge parapet. The upper surface of each abutment is flat with an exterior angled corner. Marking the exterior parapet wall of the abutments is an incised groove. The surface of the abutment beneath the parapet wall is slightly inset, while the adjacent bridge spandrels are slightly inset from the plane of the abutment. Steel guard rails are bolted to the interior ends of the parapet walls of the abutments and are angled outward from the sides of the bridge. The east approach road curves to the northeast at the east end of the bridge.

The bridge spans consist of two shallow stilted, segmental arches. These arches spring from the caps of the central pier. The arches are echoed by molded ribs. These ribs widen slightly near the junctions with the abutments and meet the abutments at an angle. On the north side of the bridge, a portion of the concrete surface of these ribs has deteriorated, exposing the steel reinforcing bars. In addition, the concrete on the underside of the arches has deteriorated (Meyer 1991:3). The junction of the two arches is marked by slightly projecting pilasters, ornamented with oval flutes. These pilasters rise from the pier caps. The pilasters are surmounted by a concrete panel. The bridge spandrels are constructed of smooth-finished concrete, while the bridge deck is constructed of reinforced concrete. A road surface consisting of a bituminous compound overlays the concrete deck (Meyer 1991:3).

The concrete bridge parapets follow the humpback profile of the bridge deck. These ornamented parapets form a balustrade. The upper portion of the parapet is a square railing. Portions of this concrete railing have spalled (Meyer 1991:3). Beneath the railing are inset panels. Beneath the panels, the exterior walls of the parapet form two angled moldings marking the junction between the parapet and the spandrels. Rectangular balustrade panels are ornamented with triple groupings of a star pattern formed by two overlapping crosses, each offset by 45 degrees. Each panel is separated by unornamented balusters. The balustrade above each arch consists of six ornamented star panels, a plain rectangular concrete panel, and six additional star panels. A balustrade panel in the north parapet near the center of the bridge has deteriorated to such an extent that it has angled out from the plane of the parapet wall, and portions of the reinforcing bars are visible.

At the midpoint of each parapet is a rectangular concrete panel. A plaque is mounted on the interior side of each panel. Each plaque, rectangular in shape with an arched top, is fabricated from bronze and provides identical information about the construction of the bridge. The text reads:

> Built by the Commonwealth of Pennsylvania 1919; Governor William C. Sproul; Auditor General Charles A. Snyder; State Treasurer Harmon M. Kephart; L.W. Mitchell Secretary; George A. Shriner Superintendent; G.A. Flink, Engineer; Commissioners of Snyder County H.A. Bowersox, O.B. Sanders, L.F. Hummel, M.I. Potter, Atty., T.F. Shambach, Clerk. Whittaker and Diehl, Harrisburg, Pennsylvania.

BACKGROUND HISTORY

Stone Arch Bridges

Penns Creek Bridge is a concrete arch structure. However, the technology of concrete arch construction developed from the earlier technology of stone arch construction. Stone bridges, first built by the Etruscans and the Romans (Condit 1961a:240), were introduced in North America during the colonial period. The earliest known stone bridge in the United States that still carries a modern highway is Philadelphia's Frankford Avenue Bridge. This bridge was constructed in 1697 as part of the King's Road (Commonwealth 1986:37).

As a building material, stone has substantial compression strength but lacks tensile strength. As a result, stone bridges were generally constructed with semi-circular or segmentally curved arches (Commonwealth 1986:34,157). Construction of stone arch bridges was time consuming and labor intensive. A stone arch bridge required the expertise of a skilled stone mason and workers competent in laying stone and producing the strongest mortar mix to maximize the strength of the structure. Because of cost, time, and the shortage of skilled craftsmen (Schodek 1987:72), other materials supplanted stone as the predominant bridge building materials in the United States.

Concrete Arch Bridges

One of the materials that supplanted stone was concrete. While concrete has high compression strength (McCormac 1978:1), like stone, it also has a low tensile strength. Tensile strength can be increased substantially with steel reinforcing. The development of steel reinforcing permitted the construction of concrete bridges with long span lengths. After the perfection of steel reinforcing, concrete became the favored type of masonry bridges. A reinforced concrete bridge can generally be erected more rapidly than a stone bridge of the same length. Although expertise is required to insure the proper mixture and curing of concrete, fewer skilled workmen are required to erect a concrete arch bridge than are required to erect a stone arch bridge.

The technology of reinforced concrete arches was largely developed by French theorists and inventors and Swiss engineers. By 1885 the French had constructed small reinforced arches in which wire mesh reinforcing was imbedded in the concrete and bent in a curved surface approximating the undersurface of the arch. By 1890, the Swiss had built at least three reinforced concrete bridges with spans exceeding 120 feet (Condit 1961a:247-248).

The first concrete arch bridge in the United States was the Cleft Ridge Span constructed in 1871 in Prospect Park, Brooklyn, New York. This bridge lacked reinforcing (Commonwealth 1986:11). The first application of European reinforced concrete arch technology in bridges in the United States occurred in 1889. In that year Ernest L. Ransome built a reinforced concrete arch bridge, the Alvord Lake Bridge in Golden Gate Park, San Fransciso, California. This bridge is almost a vault rather than an arch. Its span is 20 feet, and its overall width is 64 feet. Reinforcing consists of a series of twisted iron bars imbedded longitudinally in the bridge soffit (Condit 1961a:248-249). Typical of early concrete arch bridges, the surfaces of the span were finished to imitate quarry-faced stone masonry.

The first reinforced arch bridge in the East was constructed in 1893-1894 to carry Pine Road over the Pennypack Creek in Philadelphia. The bridge consisted of two arches, each with a span of 25 feet 5 inches. The reinforcing consisted of sheets of half-inch wire mesh spaced in the horizontal and vertical planes of the concrete at intervals of two feet. The exterior of the bridge was finished in imitation of rough-textured stone masonry (Condit 1961a:249).

The popularization of reinforced concrete as a bridge building material was largely the result of the introduction in the United States of the method of reinforcement invented by Viennese engineer Joseph Melan. The technique involved the combination of two different systems of arch construction. Reinforcing consisted of a series of parallel iron or steel I-beams, curved to the profile of the soffit. Melan effectively combined the iron arch rib with the masonry arch. The first bridge in the United States to use the Melan reinforcing system was a small span in Rock

Rapids, Iowa, designed by Fritz von Emperger and constructed in 1894. Because it did not make efficient use of metal reinforcement in reducing sheer stresses, the original Melan system was used for only a small number of bridges (Jackson 1989:228). Improvements to the Melan system were undertaken to reduce the amount of reinforcement material needed and to increase the stability of the reinforced structure.

In 1898, F.W. Patterson, an engineer for the Department of Public Roads of Allegheny County, Pennsylvania, began to design small highway bridges in which he introduced modifications of the Melan system. One modification was to replace a single barrel arch with two or more separate parallel concrete ribs, each with its steel reinforcing beam. Another was to form the bridge deck into a series of small arches between the steel beams, a technique similar to that employed in concrete floor construction of steel framed buildings. A final modification expanded on the system of deck reinforcing. Two deep I-beams were added on either side of the deck, and concrete girders were poured around the beams. This system enabled the arch to be eliminated entirely and was the prototype for the modern concrete span bridge (Condit 1961a:253).

Techniques of concrete arch bridge construction in the United States have generally changed very little since the late nineteenth century (Condit 1961b:195). Although the Melan system of bridge reinforcing has not been totally abandoned, its reliance on heavy steel ribs or beams has proved to be unnecessary for most bridges. Instead, most barrel arch bridges are reinforced with steel rods, and in most larger bridges, the arch barrel is divided into a series of parallel ribs (Condit 1961a:253). Typically the rods are first placed in a framework and the concrete is mixed wet and worked under the bars. The arch ring for the typical concrete arch bridge is built in transverse section, and each section is completed in a continuous operation (Ketchum 1908:371). Penns Creek Bridge contains barrel arches reinforced with steel rods.

Humpback Bridges

Penns Creek Bridge is one of a relatively small number of humpback concrete arch bridges in Pennsylvania. Others include the multiple-span, 300-foot long, Dauberville Bridge that carries Belleman's Church Road over the Schuykill River in Center Township, Berks County, Pennsylvania (Commonwealth 1986:166) and the single-span, 72-foot long, Campbell's Bridge that carries Allentown Road over Unami Creek in Milford Township, Bucks County (Commonwealth 1986:167). The Dauberville Bridge was constructed in 1908, and Campbell's Bridge was constructed in 1906.

Humpback stone arch bridges had been built in Europe since the time of the Roman Empire. An early extant English example is the seventeenth century bridge, Brig O'Doon (Richards 1984:3). The humpback design was often used to conserve materials when topography made a single large arch the preferable arch shape. The technology of the humpback bridge was introduced to the American colonies by craftsmen familiar with European models.

There is no structural advantage to the use of the humpback in concrete bridges. Most of the twentieth century concrete arch bridges in Pennsylvania employed a flat bridge deck. The few humpback concrete arch bridges included in the Pennsylvania bridge survey of 1986 were small bridges located in rural areas.

The humpback design may have been used to evoke associations with early stone bridges of Pennsylvania, many of which had a humpback profile (Commonwealth 1986:166). Among these early bridges were a single-span bridge in Lewistown, Pennsylvania, located on a secondary turnpike between Harrisburg and Pittsburgh and built in 1813, and the multiple-span Perkiomen Bridge at Collegeville, Pennsylvania, built in 1791 (Shank 1966:31).

A more practical reason for the use of the humpback design was economy. According to bridge historian Robert Vogel, such bridges were frequently constructed on lightly traveled country roads where a relatively high crossing was necessary to avoid flooding. A humpback bridge was less costly to build than a flat bridge which would have required long approach ramps (Vogel 1992).

Gustav A. Flink

Penns Creek Bridge was built in 1919 to a design of Gustav A. Flink. Flink, a Harrisburg consulting engineer, apparently began his career as a draftsman for the Pennsylvania State Highway Department (Boyd 1910). He later established his own consulting engineering practice with offices at 222 Market Street in Harrisburg (Boyd 1913).

In addition to Penns Creek Bridge, Flink is known to have been involved in the design or construction of at least two other vehicular bridges in Pennsylvania. In 1919, he designed the L.R. 19117 bridge over a branch of the Susquehanna River in Scott Township, Columbia County. This masonry arch bridge, spanning 10 feet, has a concrete headwall at one end and a stone headwall at the other end. In addition, Flink is listed as the contractor/builder for a 1925 bridge carrying State Route 100 over Brandywine Creek at the border of Delaware and Chester counties. This closed spandrel; elliptically arched, concrete bridge has six spans, each measuring 80 feet. Flink's whereabouts after 1925 are unknown.

Whittaker and Diehl

During the early twentieth century, bridge companies specializing in reinforced concrete structures flourished as the popularity of this building material increased (Commonwealth 1986:17). Penns Creek Bridge was built by one of these companies, Whittaker and Diehl, a Harrisburg contracting firm. The firm, which was in operation from 1908 until 1945, built both concrete and metal truss bridges in eastern and central Pennsylvania. Nineteen Whittaker and Diehl bridges in Pennsylvania have been identified (pp. 9-10).

A majority of the identified bridges built by the firm are concrete arch structures. These bridges, most of which employ elliptical arches, range in size from a single span, 44 foot-long bridge in South Woodbury Township, Bedford County that carries L.R. 05101 over Beaver Creek to a 14-span, 1,567-foot long bridge in Reading that carries U.S. Route 222 across the Schuykill River. The firm's smaller concrete arch bridges generally have closed spandrels, while the longer bridges generally have open spandrels.

Four of the identified bridges built by Whittaker and Diehl are of steel truss construction. Two are Warren trusses; one is a Pratt truss; and one is a Parker truss. The two Warren truss bridges are both single spans and are located in the Sugar Creek vicinity of Bradford County. The four-span, 575-foot long, Pratt truss bridge carries West Twenty-first Street across the Lehigh River in Whitehall Township, Lehigh County and Northampton, Northampton County. The four-span, 676-foot long, Parker truss bridge carries T.R. 35 across the Juniata River in Milford Township, Juniata County. This bridge, built in 1937, is the last identified bridge commission of the firm.

Whittaker and Diehl was established by John Fleming Whittaker and David Leslie Diehl. Whittaker was born in Curwensville, Pennsylvania in 1872. In about 1895, he began working for Eyre Construction Company of Philadelphia, a firm that fabricated steel truss vehicular bridges, as well as many of the Pennsylvania Railroad's bridges (John F. Whittaker 1929).

Whittaker moved to Harrisburg in 1908. He was a principal in Whittaker and Diehl from the time of its founding to his death in 1929. After the establishment of Whittaker and Diehl, John F. Whittaker participated in the organization of a bridge company in nearby York. Recorded in his obituary as the Luter Bridge Company (John F. Whittaker 1929), this was probably a reference to the Luten Bridge Company. Established by Daniel Luten, the company produced catalogs illustrating a wide variety of arch styles, from monumental, multiple-span city bridges to small, ornamental park bridges. Luten built or licensed hundreds of bridges throughout the east and midwest (Commonwealth 1986:17). Whittaker apparently served as an officer of the Luten Bridge Company (John F. Whittaker 1929).

Whittaker had many additional business affiliations during his residence in Harrisburg. He helped organize Appleby and Whittaker, a wholesale plumbing supply firm (John F. Whittaker 1929). He served as president of the

Harrisburg Coca-Cola Bottling Company; as president of the Lewisburg, Milton and Watsontown Passenger Railway Company; as treasurer of DX Instrument Company, a manufacturer of radio instruments (Polk 1924); and as vice president of the Hill Discount Company, a loan broker (John F. Whittaker 1929). In addition, he was a principal of three other construction firms, each of which shared an office with Whittaker and Diehl and may have been its subsidiaries. These included Ferro Concrete Company (Boyd 1908, passim.); Simplex Construction Company (Boyd 1913); and J.C. Shawfield Company (Polk 1923, passim.). Ferro Concrete Company was also a bridge contractor. Four bridges by this firm have been identified (p. 11).

David L. Diehl was a principal in Whittaker and Diehl throughout its entire history. In his will, probated in October 1945, he stipulated that the firm was to be dissolved if its sale would yield less than its book value (Dauphin County Will Book (N-2:445, October 9, 1945). Diehl had also been involved in a variety of other business enterprises. He served as vice president of DX Instrument Company (Polk 1924), as vice president and treasurer of the J.C. Shawfield Company (Polk 1930, passim.), and as secretary-treasurer of the Lewisburg, Milton, and Watsontown, Passenger Railway Company (Boyd 1910, passim.).

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PARTIAL LIST OF PENNSYLVANIA HIGHWAY BRIDGES BUILT BY WHITTAKER AND DIEHL			
DATE BUILT	TYPE OF BRIDGE	LENGTH/SPANS	LOCATION
1914	Concrete; elliptical arch, open spandrels	357 feet (5 spans)	Main Street, Amity and Union townships (Berks County) over Schuylkill River
1915	Steel; Parker truss	73.4 feet (1 span)	L.R. 08185, West Burling Township (Bradford County) over Sugar Creek
1915	[Not indicated]	[Not indicated]	S.R. 19, Davidson Township (Sullivan County) [probably demolished]
1915	Concrete: elliptical arch, solid spandrels	44 feet (1 span)	L.R. 05101, South Woodbury Township (Bedford County) over Beaver Creek
1916	Concrete: elliptical arch, solid spandrels	60 feet (1 span)	Meetinghouse Road, Upper Chichester Township (Delaware County) over Branch of Naamans Creek
1918	Concrete; elliptical arch, open spandrels	60 feet (1 span)	Lower Towamensing Township (Carbon County) over Buckwha Creek
1919	Concrete: stilted segmental arch, closed spandrels	164 feet (2 spans)	L.R. 54013, Monroe and Penn townships (Snyder County) over Penns Creek
1920	Concrete: elliptical arch, open spandrels	1,567 feet (14 spans)	U.S. 222 (Bingamen Street), Reading (Berks County) over Schuylkill River
1921	Concrete: elliptical arch, solid spandrels	223 feet (2 spans)	PA 443, New Ringold Borough (Schuylkill County) over Little Schuylkill River
1923	Concrete: elliptical arch, solid spandrels	277 feet (3 spans)	T.R. 220, Pine Creek Township (Clinton County) over Pine Creek
1924	Concrete: elliptical arch, open spandrels	1,009 feet (12 spans)	L.R. 232, West Pittston (Luzerne County) over Susquehanna River
1925	Concrete: elliptical arch, open spandrels	249 feet (3 spans)	L.R. 17, Monroe Township (Bradford County) over Towanda Creek
1925	Concrete: elliptical arch, solid spandrels	71 feet (1 span)	Sunbury Street, Minersville Borough (Schuylkill County) over West Branch, Schuylkill River
1927	Concrete: elliptical arch, open spandrels, triple ribs	866 feet (13 spans)	Mineral Springs Road (L.R. 146), Reading (Berks County) over Mineral Springs Creek
1927	Concrete: elliptical arch, open spandrels	530 feet (5 spans)	State Street, Hamburg (Berks County) over Schuylkill River

PARTIAL LIST OF PENNSYLVANIA HIGHWAY BRIDGES BUILT BY WHITTAKER AND DIEHL			
DATE BUILT	**TYPE OF BRIDGE**	**LENGTH/SPANS**	**LOCATION**
1927	Concrete: elliptical arch, open spandrels	1,020 feet (7 spans)	PA 82 (Furnace Street), Birdsboro (Berks County) over Schuylkill River
1933	Steel: Pratt truss	575 feet (4 spans)	PA 329 (W. 21st St.), Whitehall Twp. and Northampton (Lehigh and Northampton counties) over Lehigh River
1937	Steel: Parker truss	676 feet (4 spans)	T.R. 35, Milford Township (Juniata County) over Juniata River
Unknown	Steel: Warren truss	78 feet (1 span)	L.R. 08069, Burlington (Bradford County) over Branch of Sugar Run Creek

Sources: Pennsylvania Department of Transportation. *Pennsylvania Historic Resource Survey. State Highway Bridges.* Forms filed at the Pennsylvania Historical and Museum Commission, Harrisburg, 1982.

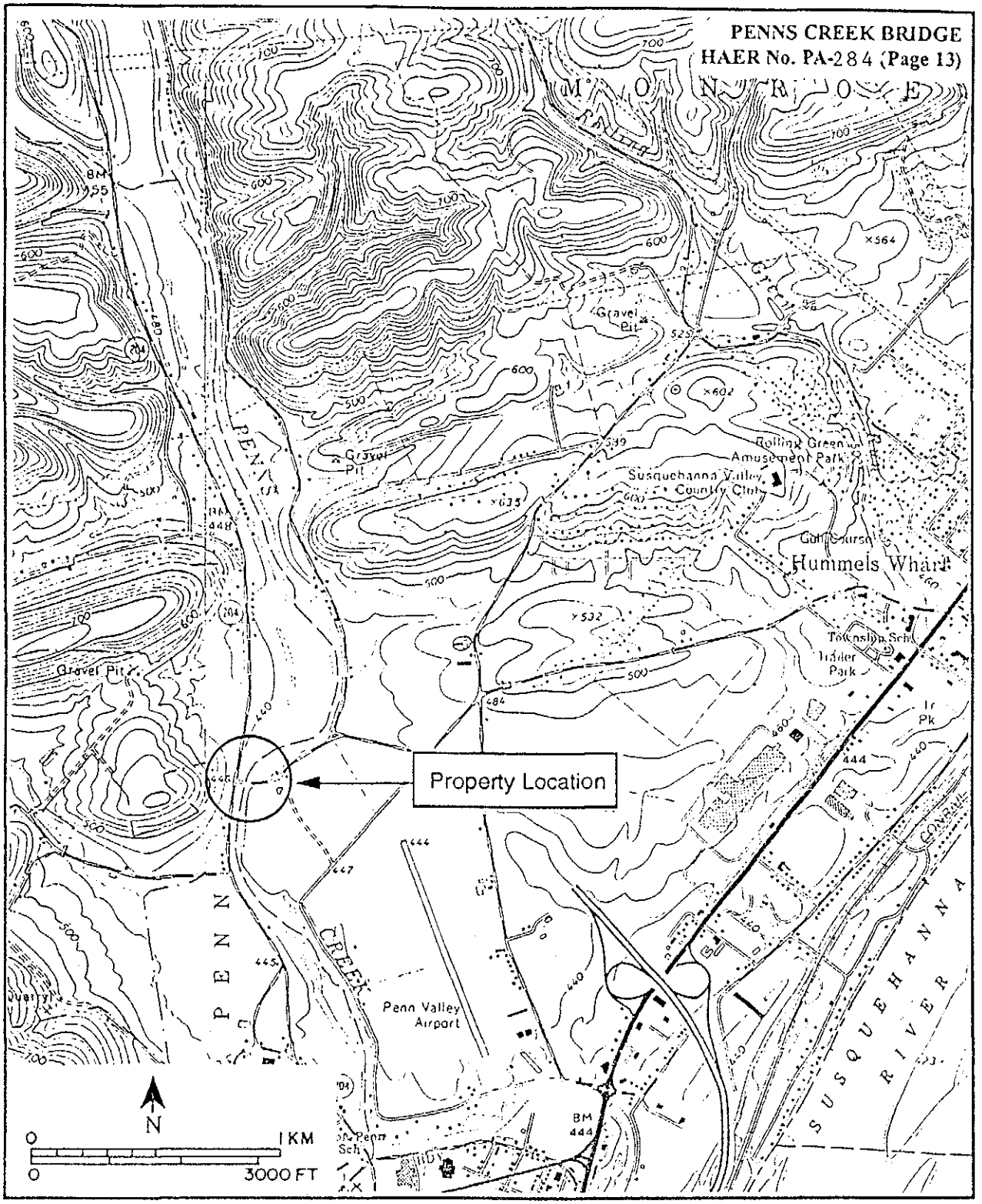
Sullivan County bridge listed in Commonwealth of Pennsylvania. *Report of the State Highway Department of Pennsylvania.* 1914-1917. Harrisburg: J.L.L. Kuhn, 1918.

PARTIAL LIST OF PENNSYLVANIA HIGHWAY BRIDGES BUILT BY THE FERRO CONCRETE COMPANY

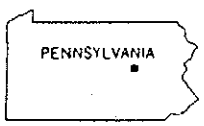
DATE BUILT	TYPE OF BRIDGE	LENGTH/SPANS	LOCATION
1908	Concrete: elliptical arch, solid spandrel	84 feet (1 span)	L.R. 36011, Elizabeth and Warwick townships (Lancaster County) over Hammer Creek
1911	Concrete; elliptical arch, solid spandrels	47 feet (1 span)	L.R. 35 (Rte. 11), Shippensburg (Cumberland County) over Middle Spring Creek
1916	Concrete: elliptical arch, solid spandrels	55 feet (1 span)	L.R. 83 (U.S. 6), Linesville (Crawford County) over Linesville Creek
1918	Concrete (?)	108 feet (3 spans)	Route 32, Derry Township (Mifflin County) [probably demolished]

Sources: Pennsylvania Department of Transportation. *Pennsylvania Historic Resource Survey. Highway Bridges.* Forms filed at the Pennsylvania Historical and Museum Commission, Harrisburg, 1982.

Mifflin County bridge listed in Commonwealth of Pennsylvania. *Report of the State Highway Department of Pennsylvania.* 1917-1920. Harrisburg: J. L. L. Kuhn, 1922.

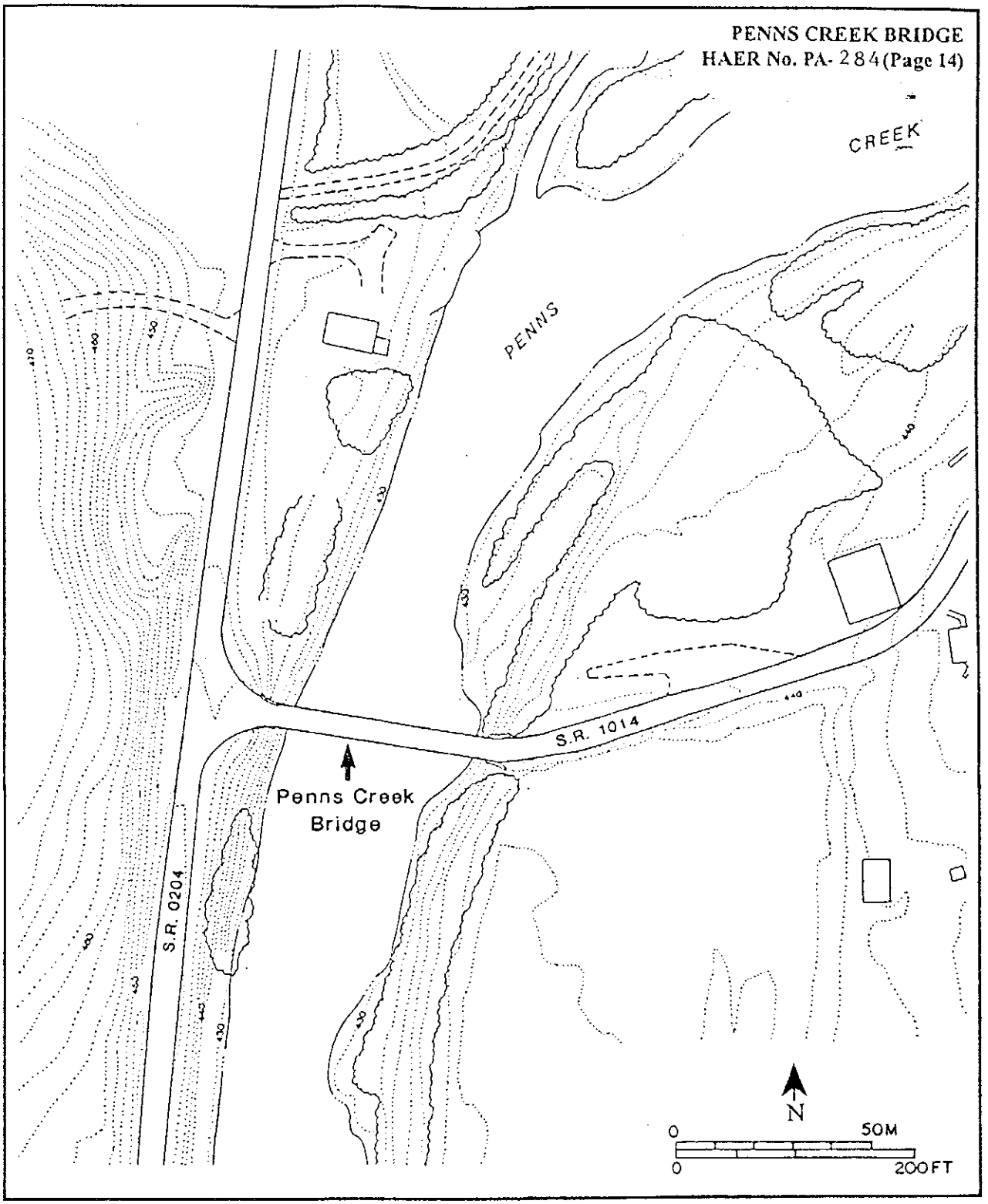


Property Location



Quadrangle Locations

USGS 7.5 Minute Series
Freeburg and Sunbury, Pa. Quadrangles
Photorevised 1973 Editions


PENNS CREEK BRIDGE
HAER No. PA-284 (Page 14)
CREEK
PENNS
S.R. 1014
Penns Creek
Bridge
S.R. 0204
N
0
50M
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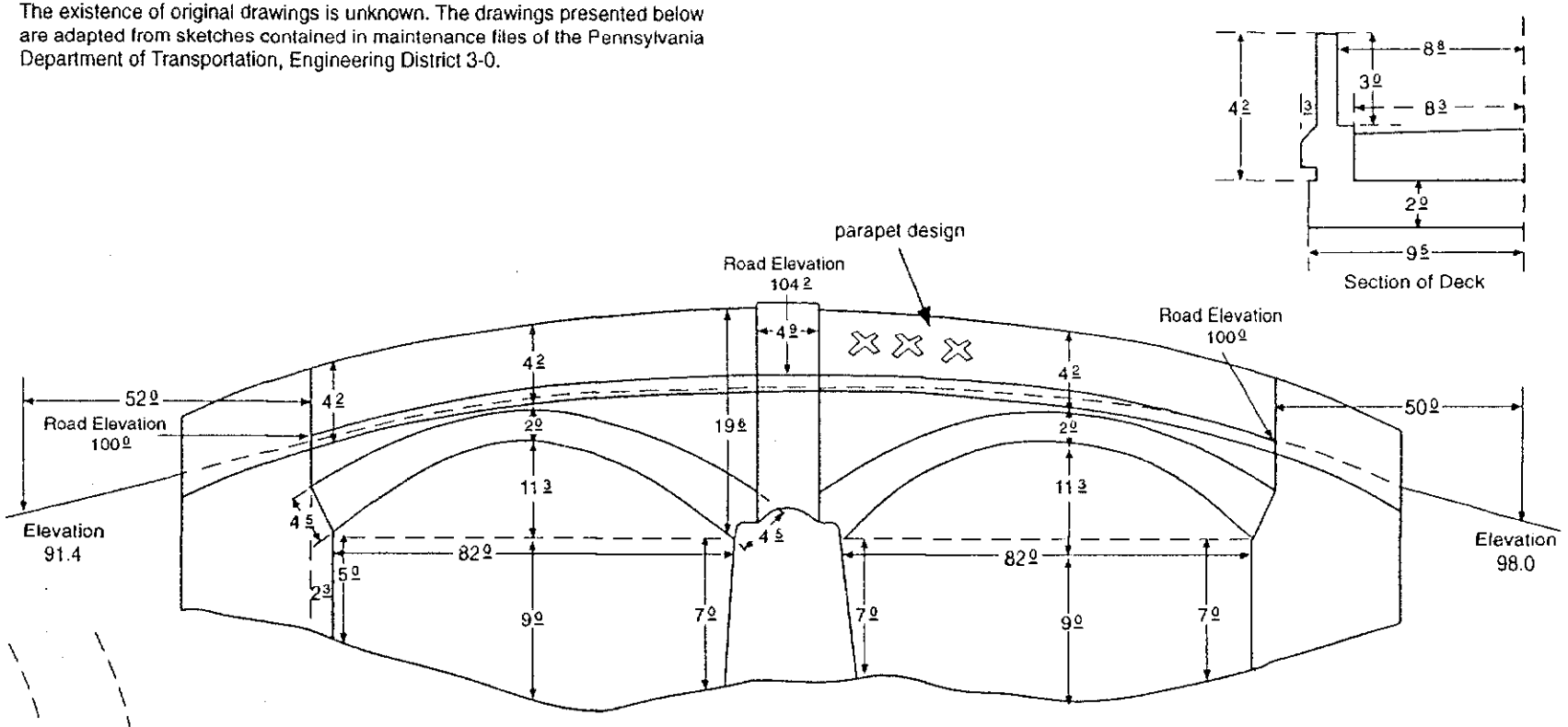
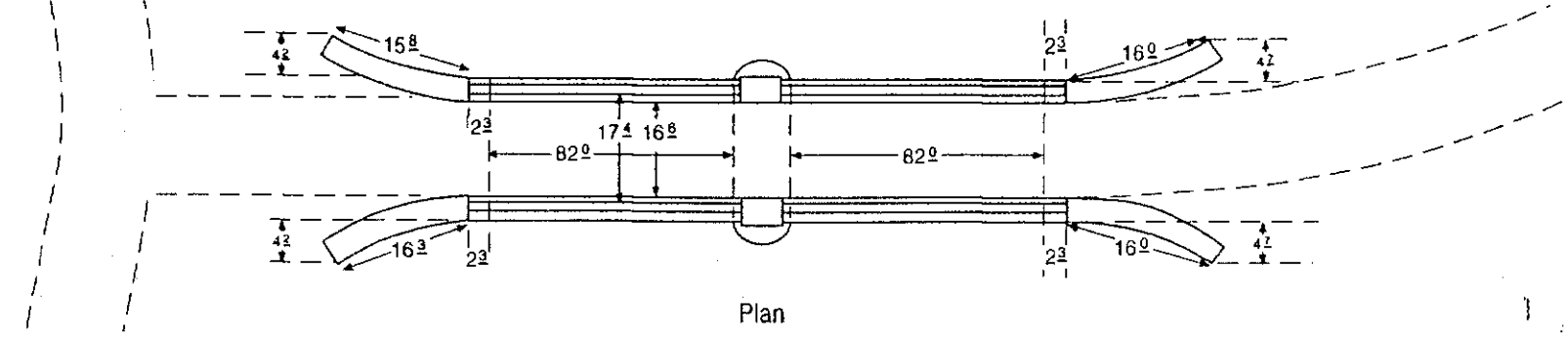
200FT

Site Plan

The existence of original drawings is unknown. The drawings presented below are adapted from sketches contained in maintenance files of the Pennsylvania Department of Transportation, Engineering District 3-0.





PENNS CREEK BRIDGE
HAER No. PA-284 (Page 15)